DOCUMENT RESUME

ED 230 379 SE 041 576

AUTHOR Iozzi, Louis A.
TITLE People and Environmental Changes. Teacher's Guide. Preparing for Tomorrow's World.
INSTITUTION Rutgers, The State Univ., New Brunswick, N.J. Center for Coastal and Environmental Studies.
SPONS AGENCY New Jersey State Dept. of Education, Trenton.
PUB DATE 82
NOTE 38p.; For related documents, see SE 041 564-585. A complete catalog of the multi-media packages making up this program is contained in SE 041 585.
AVAILABLE FROM SOPRIS WEST, Inc., 1120 Delaware Ave., Longmont, CO 80501 (Complete multi-media module, including student materials, $75; replacement student worksheets, $2).
PUB TYPE Guides - Classroom Use - Guides (For Teachers) (052)

EDRS PRICE MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS *Change; Climate; Critical Thinking; Decision Making; *Environmental Education; Environmental Influences; *Futures (of Society); High Schools; Interdisciplinary Approach; Learning Activities; Moral Development; *Moral Issues; *Physical Environment; Pollution; *Problem Solving; Role Playing; Science Education; Secondary School Science; Social Studies; Technology; Weather
IDENTIFIERS Acid Rain; Dilemma Discussion Approach; Preparing for Tomorrows World Program; *Science and Society

ABSTRACT

"People and Environmental Changes" is one of the "Preparing for Tomorrow's World" (PTW) program modules. PTW is an interdisciplinary, future-oriented program which incorporates information from the sciences and social sciences and addresses societal concerns which interface science/technology/society. The program promotes responsible citizenry with increased abilities in critical thinking, problem-solving, social/ethical reasoning, and decision-making. This teaching guide discusses the purposes of the module (which includes an examination of issues that arise as a result of human activities in the physical environment), general strategies employed (focusing on the dilemma debate/discussion technique), module structure and objectives, and use of dilemmas in the school curriculum. Instructional strategies are provided for the readings, activities, dilemmas, and discussions presented in the two-section student manual (section 1 focusing on planned environmental changes and section 2 focusing on unplanned environmental changes). A chart indicating moral issues (as defined by Kohlberg) contained in the dilemmas presented in the student materials, suggested schedule of activities, and bibliography on environmental modification are also provided. The module may be used as a separate unit of study, as a mini-course, or incorporated into such existing subject areas as social studies, language arts, or science. (JN)

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
✓ This document has been reproduced as received from the person or organization originating it.
☐ Minor changes have been made to improve reproduction quality.
• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

ED230379

PREPARING FOR TOMORROW'S WORLD

People and Environmental Changes

Teacher's Guide

"PERMISSION TO REPRODUCE THIS MATERIAL IN MICROFICHE ONLY HAS BEEN GRANTED BY
Duane C. Webb
TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

Institute for Science, Technology and Social Science Education

SE041576

Preparing for Tomorrow's World
An Interdisciplinary Curriculum Program

Coastal Decisions: Difficult Choices
Energy: Decisions for Today and Tomorrow
Future Scenarios in Communications
Space Encounters
Technology and Changing Life-Styles
Perspectives on Transportation
People and Environmental Changes
Environmental Dilemmas: Critical Decisions For Society
Of Animals, Nature and Humans
Beacon City: An Urban Land-Use Simulation
Dilemmas in Bioethics
Technology and Society: A Futuristic Perspective

PREPARING FOR TOMORROW'S WORLD

People and Environmental Changes

Teacher's Guide

Prepared by:

The Center for Coastal Studies
Dr. Louis A. Iozzi, Director
Doolittle Hall
Rutgers • The State University of New Jersey
New Brunswick, New Jersey 08903

Published and Distributed by:

Sopris West, Inc.
1120 Delaware Avenue
Longmont, CO 80501
(303) 651-2829

Copyright© 1982 Rutgers • The State University of New Jersey

PREFACE

TO THE TEACHER:

We live in an exciting, rapidly changing, and challenging world—a world highly dependent upon science and technology. Our world is changing so rapidly that we sometimes fail to recognize that much of what we today take for granted as common, everyday occurrences existed only in the imaginations of people just a few short years ago. Advances in science and technology have brought many dreams to fruition. Long before today's school children become senior citizens, much of today's "science fiction" will, in fact, become reality. Recall just a few accomplishments which not long ago were viewed as idle dreams:

- *New biomedical advances have made it possible to replace defective hearts, kidneys and other organs.*
- *The first aire flight at Kitty Hawk lasted only a few seconds. Now, a little over half a century later space ships travel thousands of miles an hour to explore distant planets.*
- *Nuclear technology—of interest a few short years ago because of its destructive potential—could provide humankind with almost limitless supplies of energy for peace-time needs.*
- *Computer technology has made it possible to solve in seconds problems which only a decade ago would require many human lifetimes.*
- *Science and technology have brought us to the brink of controlling weather, earthquakes and other natural phenomena.*

Moreover, the changes which we have been experiencing and to which we have become accustomed are occurring at an increasingly rapid rate. Changes, most futurists forecast, will continue and, in fact, even accelerate as we move into the 21st Century and beyond. But, as Barry Commoner has stated, "There is no such thing as a free lunch." These great advances will not be achieved with a high price. We are now beginning to experience the adverse effects of our great achievements:

- *The world's natural resources are being rapidly depleted.*
- *Our planet's water and air are no longer pure and clean.*
- *Thousands of plant and animal species are threatened with extinction.*
- *Nearly half the world's population suffers from malnutrition.*

While science and technology have given us tremendous power, we are also confronted with an awesome responsibility: to use the power and ability wisely, to make equitable decision tradeoffs, and to make valid and just choices when there is no absolute "right" alternative. Whether we have used our new powers wisely is highly questionable.

Today's youth will soon become society's decision-makers. Will they be capable of improving upon the decision-making of the past? Will they possess the skills and abilities to make effective, equitable, long-range decisions to create a better world?

It is our belief that the *Preparing for Tomorrow's World* program—will help you the teacher prepare the future decision-maker to deal effectively with issues and challenges at the interfaces of science/technology/society. It is our belief that the contents and activities in this program will begin to prepare today's youth to live life to the fullest, in balance with Earth's resources and environmental limits, and to meet the challenges of tomorrow's world.

Louis A. Iozzi, Ed. D.
Cook College
Rutgers-The State University of New Jersey

CONTENTS

Page

Introduction 1

Overview Of
People And Environmental Changes 3

Purpose 3
Strategy 3
Objectives of the Module 4
Components of People and Environmental Changes 4

Guide To Section I:
Planned Environmental Changes — Teaching Strategies And Student Activities

Overview 7
Activity 1: The Rainmakers 8
Activity 2: Controlling the Rain 9
Activity 3: The Dam Builders 17

Dilemma 1: "Make Way for the Dam" 17
Dilemma 2: "The Endangered Plant" 17

Guide To Section II:
Unplanned Environmental Changes — Teaching Strategies And Student Activities

Overview 19
Activity 4: Introduction to Section II 20
Activity 5: Unintentional Weather Changes 21

Dilemma 3: "Rain, Unwanted at Harvest Time" 21
Dilemma 4: "Acid Lake and Jobs" 22

Activity 6: Unintentional Land Changes 25

Dilemma 5: "Too Many Animals" 25
Dilemma 6: "A New Theory" 25
Dilemma 7: "Courting Disaster" 25

Activity 7: Directions for the Future 25

Suggested Schedule of Activities 26

Appendices

War Between the States 27
Power to the People 30
The National Weather
Modification Policy Act of 1976 31

Selected Bibliography:
Environmental Modification 34

INTRODUCTION

"Man as an implement maker, the first and such on earth, has the power to transform landscapes and to manage soil and water resources so he has become, in effect, himself a major force of geological changes. When the first man or men began to fashion sticks, stones and bones to serve a given purpose, the metamorphosis began."

Russell Lord
The Care of the Earth: A Story of Husbandry

Russell Lord's eloquent commentary about man's unique ability as a tool maker views human activity as a dominant agent in changing the earth as well as a contributor to the processes of change. While men have altered earth's surface since their earliest beginnings, we in the twentieth century are witnessing some of the most sweeping and rapid changes in history. These events, however, may only be harbingers of even greater and faster changes in the future.

Advances in science and technology have enabled us to transform and utilize earth's many resources to provide for a more comfortable, pleasurable way of life and protection from the often hard and unpredictable forces of nature. In the process of devising means and products to meet our needs and desires, we discover that our activities frequently have undesirable consequences. Mining activities have left ugly, permanent scars on the landscape. Wildlife habitats have been destroyed as we tame rivers, lining them with dams and power plants to meet our water and energy needs.

While undesirable changes are not new, such as the transformation of the once fertile plains of ancient civilizations into windswept deserts, we have today far more powerful tools capable of literally moving mountains overnight, our tools creating the possibility of producing undesirable changes of even greater magnitude. We also have the knowledge and means to detect formerly unperceptible effects of our activities that can contribute to possible future dislocations. For example, invisible fluorocarbon aerosol sprays have been blamed for depleting atmospheric ozone. Hence, we are now more aware of and can assay effects that have long been accumulating. With the pressures of growing populations, we find problems of greater intensity surfacing.

It is without question that humans will continue to modify the environment. How we can better direct our efforts to ensure that future changes will not threaten the very survival of life on earth is the challenge that confronts all of us. In particular, we, as educators, must begin to assist our students to recognize the many effects of our activities and the decisions we make in private and public life which contribute to change.

Choices and decisions that confront us are in part scientific and technological in nature. However, underlying each choice and decision are value considerations. For example, we at the same time value the convenience and "necessity" of automobile travel and the importance of clean, healthy air. Confronting us is the difficult dilemma of solving the problem of air pollution while trying to maintain our current lifestyle. To what extent are we willing to accept the contaminants we introduce into the air through our activities? What trade-offs should we make in order to nullify the undesirable consequences? Questions of this nature will arise with increasing frequency because human activities will continue to impact upon the environment.

It is our belief that insight into our value and ethical systems may guide us in seeking answers to these questions. Through effective value analysis activities and strategies to promote socio-scientific reasoning in the classroom we may better prepare our future citizenry for more adequate conflict resolution and decision making.

The goal of this module, *People and Environmental Changes*, is therefore two-fold. Examination of some of the ways science and technology have impacted on the environment will create new understandings about how people have sought to control and modify their environment. Examining the implications and consequences of these activities on natural, social, economic and political systems will raise moral/ethical considerations. By addressing the issues from this framework, it is hoped that the concept of Homo sapiens as change makers and controllers of change will be viewed from a broader perspective and with a greater awareness of multiple interacting relationships in the change process.

The first section of this module will highlight a selected sample of issues that arise from the application of new technologies to modify the environment. In the second section some of the inadvertent or unplanned modification effects arising as a consequence of other activities will be examined. In both sections students will be challenged to address these issues from a variety of perspectives and become actively engaged in problem resolutions. From this type of participation it is hoped that our students, as responsible citizens of the future, will begin to recognize their role as "shapers" of planet Earth.

Overview Of *People And Environmental Changes*

Purpose

The intent of this module is to engage students in the examination of some of the many issues that arise as a result of human activities in the physical environment. The issues in this module to a greater degree deal with some of the long range, less obviously apparent changes in the environment. The point to be made is that the effects of our activities do not exist in isolation but have cumulative and distant impacts, not only on ourselves but on future generations and the very survival of planet Earth. By posing problems and dilemmas of current and future concern, students should gain an increased awareness of earth as a dynamic system of organizations in a constant state of flux. The types of decisions, policies and actions taken become a critical factor in this change process.

Through critical analysis of the issues and consideration of possible consequences it is hoped that students will become wiser, more effective decision makers — decision makers with an expanded vision who possess the ability to analyse effects beyond those which effect their own personal lives.

Strategy

It is our belief that an understanding of problems/issues and a formulation of one's own ideas requires a knowledge base and a sense of personal involvement. Introductory information is provided through short articles and commentaries. Additional knowledge is developed as students begin to think about and discuss the material in the several types of activities and decision making opportunities. For the most part, opposing sides of issues are included in order that students can reflect upon and question the wisdom of a given choice or action.

The dilemma situation is one strategy used to focus on and heighten issues to more actively involve students and to demonstrate how environmental problems relate to their own lives. Many of the dilemmas are adapted from actual case histories, while others, although hypothetical, reflect critical choices that are being made today or will need resolution in the future. The simulation game and role play activities are variations of this basic format.

The dilemma debate/discussion will be the focal point of classroom activity and student interaction. This approach provides an opportunity for students to take part in the dialogue, examine alternative positions, and experience value or ethical conflict. Taking a position and defending it requires active participation and involvement on the part of the student. Hearing arguments and opinions of others will help lead them to examine the implications and consequences of their particular stance. Also, the level of relevancy becomes elevated when students hear arguments from their peers rather than from adult authority or the printed word. Although the discussion process may seem to move more slowly than imparting information through lectures or readings, it places a personal demand on the students to organize, coordinate and interrelate information and concepts. In this manner, they will begin to understand the dynamic interrelationship of environmental issues and the difficulty of decision making.

Although the dilemmas involve individuals, we have constructed the different dilemmas to reflect decisions having effects at the personal, community, national and international levels. Hence, students can begin to expand their scope of thinking and consider impacts from a variety of perspectives. In view of Piaget's model that places senior high school students at the transitional stage of formal development, many of the dilemmas consider social implications beyond one's own social sphere to those on a more global level. The intention is to move students from their egocentric orientation to that which encompasses broader areas of concern.

The dilemmas as presented are simple in form but can be further developed by the teacher with increasing complexity, depending on the intellectual and conceptual level of the students as well as their interest and curiosity. The subject area or course in which this module is taught may determine ways in which many of the concepts might be further developed — such as concepts from sociology, economics, ecology, government, philosophy, history, etc. Drawing relationships from what is learned in the course will inevitably make students' learning more meaningful and effective.

People and Environmental Changes in the School Curriculum

This module designed for the senior high school level (9 through 11) may be used in a number of subject areas: social studies, language arts, science, etc. In social science classes, comparisons may be made between different social and cultural systems and their influences on environmental changes. In the science classes, emphasis might be placed on examining the feasibility of alternative technologies. English classes might stress the analysis of arguments, debate strategies or public speaking.

The dilemmas can also serve as a "springboard" for teachers to develop additional dilemmas for their classes. So often it is the case that many of the best dilemmas are developed spontaneously from the materials that are part of the ongoing coursework. Having used these dilemmas, teachers can better understand the intent and value of dilemma discussions and begin to recognize other problematic situations that confront society. The question of relevancy and meaning can be bridged when specific information is related to its impact on future society.

All important in this strategy is to engage students in the consideration of problems and new concerns that arise from society's use of its resources. How to best insure the very existence of human society requires great wisdom which educators can nurture and develop in the classroom.

Objectives of the Module

- To increase students' knowledge of environmental issues.
- To increase students' ability to analyze issues surrounding society's impact on the environment.
- To increase the socio-scientific reasoning ability of students.
- To increase students' decision making skills by considering a range of alternative solutions.
- To increase students' awareness of conflicts of interest in the use of earth's resources.
- To increase students' understanding that environmental changes are intimately related to cultural, social, economic and political decisions and actions.
- To assist students to recognize their role as present and future change agents.
- To enable students to effectively integrate scientific-technical information and human activity.
- To increase students' ability to recognize potential effects of different types of decisions on the environment.
- To increase students' ability to develop and present effective arguments in a logical, comprehensive manner.
- To enable students to more critically examine their value systems.
- To increase students' self-esteem and ability to communicate and function more effectively in classroom discussions.

Components of People and Environmental Changes

- Student's Guide
- Teacher's Guide
- Student Handouts - 2

People and Environmental Changes is comprised of two major sections. Section I focuses on the application of science and technology to effect planned changes. Section II considers the impacts of unplanned or inadvertent environmental changes. To demonstrate socio-scientific conflicts a simulation game, role play simulations and dilemma discussion formats are utilized to highlight and heighten the underlying issues. Accompanying each activity or dilemma discussion are relevant readings to provide background information and create problem awareness. In addition, there is included after each dilemma a series of probe questions which students should consider and discuss when determining what particular action should be taken by the central role character. The questions also serve to help encourage discussions by bringing out additional aspects of the socio-scientific issues.

Each of the dilemma stories presented in this module raises two or more moral issues. Table 4 identifies the issues emphasized in each of the dilemmas.

Societal conflicts raise moral/ethical questions, and such questions form a crucial component of decision making.

This module is designed for a high degree of flexibility. The activities may be presented in the order given and serve as a single unit of study or in an order that would best relate to ongoing classroom studies. The dilemma discussions may follow directly one after another or used selectively with time intervals between each dilemma. Thus, the module can provide another dimension to the existing course or "stand on its own" as a mini-course.

Table 4

Issues Contained in Each Dilemma

Dilemma	*Issues**								
	punishment/blame	propery	affiliation role	law	life	truth	governance	civil rights/ social justice	morality/mores
Make Way for the Dam		X		X				X	
The Endangered Plant				X	X				
Rain Unwanted at Harvest	X			X				X	
The Acid Lake and Jobs							X		X
Too Many Animals			X	X			X		
A New Theory						X		X	
Courting Disaster		X					X	X	

*These basic moral issues as identified by Kohlberg comprise the underlying elements of a conflict situation involving a moral decision. Our dilemmas were constructed to incorporate two or more of these issues. Dilemma resolution requires a choice or action to be made between conflicting issues. For instance, in a dilemma dealing with the issue of governance and social justice, the questions surrounding the issue of governance include: 1) Should one accept or reject the authority of a governing body? 2) What are the characteristics and responsibilities of good government? The social justice issue raises the questions: 1) Should one defend or violate the political, social and economic rights of another person? 2) What are the bases of these rights?

Guide To Section I:

Planned Environmental Changes
Teaching Strategies and Student Activities

OVERVIEW

Weather modification and the construction of dams are the two examples used in this section to illustrate how technology has been applied to meet society's needs. In both cases, the efforts are directed towards insuring sufficient water for agriculture and human consumption. While many of the scientific and technological hurdles have been overcome, certain other social and environmental concerns and issues emerge.

The issues bring about questions such as: Who bears the responsibility for making those decisions that affect the public? In what ways can the resource be equitably shared? Does the action have adverse effects on some people and other forms of life? How should such risks be minimized?

In the simulation game and dilemma discussions students will confront and explore these issues from a number of perspectives.

ACTIVITY 1: THE RAINMAKERS

Reading 1: Excerpts from "The Magical Control of Weather

Description

The importance of rainfall to people is presented to students from a historical perspective which examines some of the rituals/rites employed to influence weather. Through analysis of one of these customs and comparison of it with another, they will consider ways in which people have identified with nature, whether it be a benevolent or capricious force to be conquered or harmoniously influenced. This exercise may also stimulate students to examine how other people perceive the role of nature as well as their own perception of the interrelationships between people and nature. In the activity where they develop a scientific explanation of rainfall to dispute the animistic concepts of nature formerly held, students will have an opportunity to review their meteorology knowledge in preparation for the subsequent activities.

Student Objectives

- To analyze how concepts of nature held by earlier cultures influenced the evolution of particular rainmaking rituals.
- To develop an explanation of precipitation based on their knowledge about weather.
- To use the above to formulate a convincing argument to persuade others of the adequacy of their explanation.

Student Activities

- The class will first read the excerpts from the "Magical Control of Weather" chapter of *The Golden Bough*, pp. 4-8 in the Student's Guide. Sir James Fraser, the author of the reading, has compiled a comprehensive description of rainmaking practices. However, his narrative reveals his personal ethnocentricity. It is important to alert students to his prejudicial and frequent depreciating comments and innuendos about peoples outside the traditions of Western culture.
- Students will meet in small groups to select one of the "rainmaking" approaches for further discussions (there should be an even number of groups). At that time, they will also summarize the beliefs of that culture and its rituals for presentation to another group.
- One group will then join another group to make their presentation and listen to the other group's presentation. Each group assumes the role of people from another culture and describes to the other group their technique or ceremony for "making rain." In their presentation they should include a brief explanation about "their" feelings toward nature and "their" ideas about how people and nature should interact.
- The groups will re-form into their original groups to prepare a second presentation. Each group will develop an explanation for rainfall based on current scientific knowledge to persuade the other group, who represents a people of another culture, to its way of thinking. Each group will at one time represent the modern scientific mode of thought and at another time the earlier mode of thought. When the students put themselves in the role of the other culture, they should evaluate the scientific explanation critically and consider whether the new explanation provides sufficient evidence or logical arguments to support that contention and can persuade them to accept that view.
- Following the presentation of the groups, each student will independently vote on whether or not he/she accepts the explanation given. Discussion of the results will conclude this activity.

Comments and Suggestions

- An important aspect of this activity is to help students develop an awareness that people have viewed nature in many different ways — to serve people, to act independent of people or to be worshipped by people. It should also elicit students' own feelings about their views of nature.
- "Presenting a scientific explanation of rain" is designed to help students review their knowledge of meteorology and better understand rainmaking technology discussed in the activity which follows.
- Students may find that people do not readily accept a new scientific explanation when their currently held beliefs are sufficient for their purposes. Examples of this pervade the history of science: the Copernican Theory stating that the earth revolves around the sun, and Galileo's discovery of the moons of Jupiter, considered heretical when first presented, are classic cases in point.

ACTIVITY 2: CONTROLLING THE RAIN

PART A — Introductory Readings

- **Reading 2:** "Rainmaking in the Modern Age"
- **Reading 3:** "Making the Weather Fit the Crop"

These two short articles briefly describe cloud seeding technologies and their current applications. They are intended to provide some general information important in understanding the simulation game in Part B.

Student Activities

Since the readings only touch upon the subject in a general manner, some students may wish to do additional research on selected topics and present short reports to the class.

A short discussion following the readings may help further students' awareness on this subject. Some questions for consideration might include:

- What groups other than farmers might benefit from cloud seeding activities?
- Is it any more important today to try to manage the weather than in the past?
- Would changing the weather have any effect on the way people live?
- Now that people can begin to make changes in weather patterns, will this make them feel that they have "conquered" nature?
- Should the government increase its research efforts in weather modification? Why or why not? What areas of research should we concentrate on? New cloud seeding chemicals? How to better control cloud seeding effects? Study the benefits of cloud seeding? Other effects of cloud seeding? Modifying hurricanes?

PART B — "You Are the Judge" — A Decision-Making Game

Description

This simulation game, using five case studies, examines some of the legal controversies created by cloud seeding activities. Students assume the role of judges in each of the five cases and through group consensus try to select the "actual" decision reached by the court. (Point values are assigned for each of the four possible choices. See below.) The Court's Decision is that decision deemed most adequate for the case in question or the court ruling from the true case. The teacher will act as moderator and announce the Court's Decision (found on pp. 21-25 of this guide) after all the groups have announced their choices.

Game Procedure

- Have students form teams of 3 to 5 members. Your experience with the students will best determine how the teams should be formed — randomly, student selection, or assigned by teacher. It is best to arrange groups in such a manner that more vocal members of the class do not preclude the involvement of less agressive students. If the class is small, teams may be comprised of pairs of students.
- The five cases will be discussed, one at a time, by each of the teams. Approximately 15 minutes are allotted for the discussion of each case, selection of one of the four choices and writing a summary statement in support of that decision.
- At the end of the 15-minute period you will call each group representative in turn to report its results. Team members will rotate the role of spokesperson. This will insure that everyone will have an opportunity to speak for the group. The results should be recorded on the blackboard or large score sheet as follows:

TEAM Name or Number	DECISION NO.	REASON
1.		
2.		
3.		
4.		
5.		
6.		

- **Challenging the Decision** — The teams need not be restricted to the choices given and may develop their own decision for the case. During its turn, the team will present the "new" choice and reasons why this decision is more adequate. The remainder of the class then votes to determine the acceptability of the "new" decision. The point value of the choice is determined by the number of "yes" votes received.

NEW DECISION

more than 50% of votes	- 4 points
25 - 50% of votes	- 2 points
less than 25% of votes	- 0 points

• After all presentations have been made and choices are recorded, (but before the Court's Decision is revealed) each team may meet briefly for 5 minutes to reconsider its particular decision. If the majority of the members concur, a team may change its choice. However, one point is forfeited for this action. Thus, if the score for that choice is 4, the team would only receive 3 points. A "poor" choice is scored "0", and therefore no points can be deducted.

Scoring

• When all selections are finalized for the case you will announce the Court's Decision and the point ratings for each decision.

• Points are awarded as follows:

	Points	
COURT'S DECISION	4	
FAIR DECISION	2	
POOR DECISION	0	
NEW DECISION	4	> 50% of votes
	2	25 - 50% of votes
	0	< 25% of votes

(Reminder: A decision that has been changed receives one less point.)

SCORE BOARD

	CASE 1	CASE 2	CASE 3	CASE 4	CASE 5	TOTAL
Team 1						
Team 2						
Team 3						
Team 4						
Team 5						
Team 6						

The scores are totalled at the end of the game and the highest scoring team is declared the winner.

CASE ONE

The Center City Flood
Court's Decision — "D"

No, the company is not liable because there is lack of proof that seeding had a direct effect on the disastrous storm.

The court decided that there was insufficient evidence to prove that cloud seeding produced significant increase of rainfall outside the "seeded" area. The fact that seeding occurred before a damaging storm does not prove that seeding caused the harm. Since the seeded area drained into Lake Thoms and Lake Thoms had never overflowed, the company had in fact successfully contained the increased water produced through its activity and is therefore not liable.

A. *Yes, the company is liable because it should not be tampering with the weather.* POOR. The question before the court does not deal with whether or not such activities should be conducted. Currently, there are no legal restraints on the use of weather resources. (0 pt.)

B. *No, the company is not liable because that storm was an act of God.* FAIR. Although the company cannot be held responsible for the storm itself, the plaintiff would have to provide evidence that the prior seeding activities contributed to the damaging effects of the storm. (2 pts.)

C. *Yes, the company is liable because the area never before had so much rainfall.* POOR. While rainfall may have increased, it does not necessarily have a direct effect on the collapse of the levee and subsequent flooding. (0 pt.)

The Court's Decision

CASE TWO

Robbing Peter to Pay Paul
Court's Decision — "B"

The farmers must stop seeding because the ranchers have a right to the rainfall Nature provides over their land.

The Texas court ruled that a landowner is entitled to the rainfall from the clouds that pass over his/her property. It reasoned that the benefits one can derive from Nature must be protected by the courts.

A. *The farmers may continue to seed clouds because there is no law stating that they cannot.* POOR. Under the U.S. common law system, conduct is lawful and cannot be penalized unless a law or decision declares it otherwise. However, in this case the question is whether a person has the right to seed clouds over someone else's property. (0 pt.)

C. *The farmers may continue to seed clouds because they have a right to protect their property.* FAIR. Since the court agreed that landowners beneath the clouds have a property right to the precipitation, they can therefore use it to their best interest. However, they can only seed above their own property. (2 pts.)

D. *The farmers must stop seeding because they are causing harm to the ranchers.* POOR. In this case there was inadequate proof that seeding caused harm. It would have been necessary to show that if seeding had not occurred, the grasslands would have been green and lush. (0 pt.)

CASE THREE

Filling the City Reservoir
Court's Decision — "A"

City X may continue to seed clouds because water is important to the welfare of the general public.

The New York court had to weigh the conflict of interest between the inconvenience to the resort owner and the need to maintain a sufficient supply of water to a city of millions. It ruled that it could not protect a private injury at the expense of a positive public advantage.

B. *City X may not continue to seed clouds because it does not have a right to disturb clouds over someone else's property.* FAIR. The question of who owns the clouds has not been clearly resolved. In this case water resource was viewed as common property to serve the interests of the state's residents. (2 pts.)

C. *City X may continue to seed clouds because there is no evidence that rain may cause flooding.* FAIR. It is only a speculation that flooding would occur. The court cannot rule on speculation of risks. (2 pts.)

D. *City X may not continue to seed clouds because it would be taking rain away from another area.* POOR. This issue was not a point of contention in this case. (0 pt.)

CASE FOUR

"Not Enough Rain"
Court's Decision — "B"

Rainfall Inc. need not return the money because it performed the services agreed upon.

The court ruled that Tom contracted for services to be performed and not the guarantee for a given amount of rain. While the claims may appear to be exaggerated, a person cannot expect miracles.

A. *Rainfall Inc. must return the money because they didn't know what they were doing and should not be in the business.* POOR. Although the rain produced was insufficient, there was no evidence that the company conducted its activities in a negligent or harmful manner. (0 pt.)

C. *Rainfall Inc. must return the money because they claimed that cloud seeding would solve the problem of insufficient rainfall.* FAIR. The company should not have overstated its claim, but it is not reasonable to expect that cloud seeding could completely reverse a drought condition. (2 pts.)

D. *Rainfall Inc. need not return the money because there is not enough proof that it was trying to cheat Tom.* FAIR. The company seeded those rain clouds that passed over, so it cannot be said that it acted with malicious intent. Tom paid what he thought was a reasonable fee. (2 pts.)

CASE FIVE

Scientific Uncertainty
Court's Decision — "A"

The state governments are not responsible for the damages because hail storms are a natural occurrence. Farmers have accepted that fact before cloud seeding became available.

The government cannot be expected to guard against naturally occurring events that prove to be damaging. Given that this was an experimental program, the government cannot offer services that have yet unproven benefits.

B. *The state governments are responsible because they could have helped the farmers if they wanted to.* FAIR. Such a problem could have been alleviated if public hearings had been held and the people were more thoroughly informed of the project and had a voice in the matter. (2 pts.)

C. *The state governments are responsible because they must insure that the people involved are adequately protected when they take on a project of such an experimental nature.* POOR. Hail storms are not normally viewed as ultra-hazardous. Hence, government is not charged with the task to provide protection. (0 pt.)

D. *The state governments are not responsible because there was no guarantee that the seeded area would benefit significantly.* FAIR. Simply because the experimental area benefited does not require that the state compensate the other areas for what benefits they did not attain. (2 pts.)

Note: The court decisions may in some cases seem contradictory or inconsistent. This is in large part due to the lack of legal precedence or regulation regarding atmospheric resources. Hence legal judgments may vary from one state to the next. Additionally, certain judgments cannot be made because conclusive proof of causation is unavailable.

PART C — "What Should be the Law"

Description:

The preceding simulation game introduced the students to some of the legal ramifications of weather modification activities and problem situations that emerge when interests conflict. Changing rainfall patterns is wrought with many complexities, and the law is unclear on many of these issues. In this exercise students are presented the task of designing a set of weather modification laws for State A that will address some of the issues.

Student Objectives:

- To examine and analyze the political, legal and ethical issues arising from weather modification activities.
- To develop a set of laws for a hypothetical state to regulate its weather modification activities.

Student Activities:

- Students will first meet in small groups to draw up a list of possible problems resulting from weather modification. Using this list for reference, they will develop a set of laws for State A which will guide its weather modification activities.
- The laws of each group are then presented by the group spokesperson for the entire class to review. The class will examine each law in turn and decide whether or not to include it among the final set of weather modification laws for State A. A simple majority vote should suffice, although group consensus is always preferable.
- Optional Activity: Upon completion of the weather modification laws for State A, students may wish to compare their laws with that of their own state. This may be obtained from local state agencies. The National Weather Modification Act of 1976 is found in the Appendix Section of this guide. This act alleviates a number of problems surrounding current activities at the national level, but it primarily addresses research concerns.

Comments and Suggestions:

- Students naturally are not expected to write laws using legal terminology. What is important is that they convey the concepts clearly. They should, in addition, apply each law to the critical test of fairness, responsibility, and generality. Also, the entire set of laws should be examined from the perspective of consistency. (i.e., Are there laws which contradict one another?)
- Students may require one or more class periods to discuss the areas that the laws should address and to write the laws. The development of the final class set of laws need to take no more than one class period.
- In selecting a single set of laws/regulations, students may find that several of the laws are similar but not identical. It may be useful to provide the students with a short discussion period where they have an opportunity to negotiate, revise, or combine laws. This would also reduce possible class friction or confusion during the class vote.
- To facilitate the development of the class set of laws it would be helpful to briefly survey the areas covered by the different groups and use these as the headings to group the laws as they are presented.

ACTIVITY 3: THE DAM BUILDERS

Part A — "People and Dams" Introductory Readings

- **Reading 4:** Introduction and excerpts from "You Can't Shoot the Rapids on a Man-Made Lake"
- **Reading 5:** Excerpts from "Daniel Boone's Wilderness May be Tamed by a Lake"

These two readings provide a brief introduction to dam building activities and serve as the information base for the dilemma discussion which follows. The second reading includes some typical types of arguments voiced by the public "in favor of" and "against" dam construction.

Few wild, free running rivers remain in the U.S. today. The desire to preserve natural wilderness areas and questions regarding the long term benefits/effects of dams has enveloped many dam building projects with much controversy. Several of these controversial issues will be highlighted in the two dilemmas.

Student Activity: Dilemma Discussion

- DILEMMA 2: "Make Way for the Dam"

The building of dams often requires resettlement of existing communities. In this dilemma the question of public and private priorities is heightened in a conflict situation involving eviction of residents from a public project area. This hypothetical situation is not unlike that which took place when plans were being made to build the Tocks Island Dam across the Delaware River in the early 1970's or the more recent Tellico Dam controversy.

Follow the basic procedure for conducting dilemma discussions as suggested in this Teacher's Guide.

Part B — "Plants, Animals and Dams" Introductory Readings

- **Reading 6:** "We Must Decide Which Species will go Forever"
- **Reading 7:** "The Endangered Species Act"

These readings raise the question: What is the responsibility of humans towards other living things? While the law covers certain aspects of this question (i.e., Endangered Species Act), other underlying moral issues need to be addressed. Further discussions and debates on these issues may be developed as an extension of the following dilemma discussion.

Student Activity: Dilemma Discussion

- DILEMMA 2: "The Endangered Plant"

This dilemma is taken from an actual case now pending in the courts. The issues of this dilemma, however, concern the rights of other living species to survival and human needs for energy and water resources. The questions which follow the dilemma should bring out other ramifications of this basic issue.

Use the format for conducting dilemma discussions as outlined in this guide.

Part C — "Distributing Power in the Northwest"

Description:

This activity is a role play simulation where class members will assume the roles of the three parties involved in a dispute over the distribution of hydroelectric power. The parties in contention are two neighboring states and the aluminum smelting industry. The questions to be resolved are "Who has the right to the electricity produced by a federally funded project?" and "How can this power be most fairly shared?"

A more detailed account of this controversy, "War Between the States," appeared in *Environmental Action* and is reproduced in the appendix section of this guide.

Student Objectives

- To examine some of the issues that arise in the allocation of a limited resource.
- To identify with a role position and develop a convincing argument in support of that position.
- To develop a solution to the controversy that is fair to all parties involved.

Student Activities

- Group Meeting: Students should first read the *Background* and *Customers Viewpoints* sections (pp. 36-37) to become familiar with the case. These selections may be read before or after the groups (3 persons/group) have been formed.
- Each student will select and represent one of the three customer viewpoints. Using the background information and his/her own ideas, each student will present to the other members of the group the arguments for his/her viewpoint and provide a solution that will resolve the controversy as well as protect his/her interests.
- Since each member will offer a different solution, the group will need to work out a compromise agreement that it believes will best resolve the conflict to everyone's satisfaction. This compromise solution is to be sumarized for a 3 to 5 minute presentation to the entire class. The rationale for this solution should be explained in the presentation.
- Class Meeting: A spokesperson from each group will present the group's solution at the class meeting. Other students will have an opportunity to question the rationale of that solution. The essential elements of each solution are to be outlined on the board. At the conclusion of the presentations, each student will cast a ballot for the solution that he/she believes will best resolve the controversy. Have the students individually indicate their choice on a slip of paper; this avoids the effects of possible peer pressure during the vote.

Guide To Section II:

Unplanned Environmental Changes Teaching Strategies and Student Activities

OVERVIEW

Unplanned detrimental consequences of people's activities quite often do not become evident until the effects have accumulated over many years and produced irreversible effects. More recently new advances in science and technology have extended our ability to detect changes that our senses are unable to discern (e.g., depletion of the ozone layer). In other cases we have accepted or taken chances on those changes, regarding consequences as a natural phenomenon beyond our ability to control (e.g., eutrophication of lakes, erosion, etc.). Increased pressures of population growth and increased rates of natural resource utilization have perhaps accelerated the pace of unanticipated consequences.

The dilemmas presented in this section focus on the issues of desertification, unintended weather modification, increases in atmospheric carbon dioxide, and erosion. While the wisdom of various activities must be questioned, it is also important to consider alternative ways in which potential problems can be circumvented. In certain circumstances some people have few options and in the struggle for survival have unintentionally decreased the productivity of the land. We, in more fortunate circumstances, may need therefore to reassess our priorities and seek more equitable and enlightened approaches to insure that our environment will continue to provide for all living things.

ACTIVITY 4: INTRODUCTION TO SECTION II

Description:

The short reading and student exercise is intended to establish the notion that human activity depends upon a complex support system, ranging from the utilization of natural resources to industrial and other human service activities. Change occurs, not only within the isolated activity, but in the total system.

Student Objectives

- To examine an activity commonly experienced in the student's life and relate it to other activities necessary to support its function.

Student Activities

- Have students read the short introduction and complete the exercise where they are to answer questions about an activity in which they were participants.
- Have several of the students describe their activity and its effects. The entire class can then consider how that activity is related or dependent on other support activities.

Comments and Suggestions

- A diagrammatic or schematic outline of the numerous interrelated activities on the board may assist students to visualize the complexity of interdependence.
- As you examine the hierarchy of interdependencies, have students consider the ways in which the environment has been altered (e.g., mining coal for electricity, landfill for waste disposal, deforestation, etc.).

ACTIVITY 5: UNINTENTIONAL WEATHER CHANGES

PART A — Air Pollution and Rainfall — Introductory Reading

- **Reading 8:** "Changes in the Weather"

This reading illustrates one of the more dramatic cases of the effects of human activity (production and consumption) on climate. However, this effect is not new or novel. Cities have long been recognized as "heat islands." London's "killer" fogs have been attributed to the burning of coal as early as the 13th Century. Consequently, coal burning was prohibited in London.

Student Activity: Dilemma Discussion

- DILEMMA 3: "Rain, Unwanted at Harvest Time"

Effects of industrial activity frequently extend well beyond the immediate area, and such effects are not necessarily welcomed. While this dilemma raises the issues of inequity for those people who must bear the detrimental effects, the underlying question to be resolved is, "How can government/public regulate or modify these inadvertent changes?"

Follow the procedure for conducting dilemma discussions as suggested in this Teacher's Guide.

PART B — "Changing Climate - Changing Activities?"

Description

In this activity students will consider the possibility of a climatic change in their local area and examine how family and community activities might change. This exercise illustrates the idea that human activities are greatly influenced by climatic conditions. That idea, in fact, has led numerous scholars to postulate theories of "climatic determinism" to explain the evolution of different customs, social interrelationships, and political and economic systems.

Student Objectives

- To project situations of different climatic conditions in their locale.
- To consider how their lifestyle might change to adapt to the new climatic conditions.

Student Activities

- Students, individually, will complete Student Handout #1, *Changing Activities,* in which they will consider how the different categories of activities might be changed if climate conditions became "hotter and wetter" and "hotter and drier." Table 2 illustrates changes predicted by Dr. Hass, a sociologist, under a different set of climate changes. This table should be examined closely before students complete their own table.
- Upon completion of their individual tables, students will convene in small groups (3 to 6) to compare their analysis and discuss their predictions. The group members will summarize their ideas about how different activities change when the climate changes for a short class presentation.

Comments and Suggestions

- Students have difficulty envisioning change or even thinking about the future. For example, Alvin Toffler, who wrote *Future Shock,* Conducted an experiment with several groups of teenage students. He asked them to make forecasts of the future and then predict events in their personal future. The disparity in the two forecasts was astonishing. Students made predictions about new technologies, robot computers, a world of upheaval and the like. In contrast, their own personal list read like a diary of their life today. They were unable to think of change in their own personal lives; they didn't see themselves as participants or being affected by change.

Therefore, to help students develop the notion of change, it will be useful to examine Table 2 in the Student's Manual with the entire class. For each of the predicted changes have the students provide an example from their personal experiences. For example, with colder and wetter weather conditions, Dr. Hass predicted "increased sibling interaction." Ask the students what they do when they have to spend most of the day inside their house. Their responses will begin to illustrate how the author arrived at his conclusion. Use this procedure for the other activities.

- You may wish to assign each group to examine change for a given season or the year. Analyzing one season at a time will perhaps prove to be less confusing for the students.

PART C — "Acid Rain" — Introductory Readings

- **Reading 9:** "Acid Rain" Fallout: Pollution and Politics
- **Reading 10:** "Pollution Parley"

The two readings define "acid rain," its source and its effects. These readings, particularly Reading 9, are more technical in nature. You may wish to assign stu-

dents to read different sections and present their summaries to the class.

Student Activity: Dilemma Discussion

- DILEMMA 4: "Acid Lake and Jobs"

This dilemma typifies situations we will encounter with greater frequency if gas and oil fueled plants convert to burn coal. Thus, in meeting our energy needs, we will need to evaluate more conscientiously our "trade-offs" when one technology is replaced by another.

- In small groups, students will briefly discuss the dilemma and questions and identify some reasons why Governor Jones should take a particular action. (This discussion period need not be as lengthy as for prior discussions since students will continue the discussion after they have completed the worksheet.)

- Have the students remain in their groups when you distribute Student Handout 2, *An Evaluation of Possible Effects*. Students may complete the worksheet individually or as a group. In the process of completing this activity, the idea of "trade-offs" should become evident.

- Each group will identify what it considers to be the two "most harmful" effects from both a short term and long term perspective for the two possible decisions. Have each group list these effects for the entire class to examine. When presenting the results, the group spokesperson should explain why those items were considered most harmful.

- Based on both the evaluation of the possible detrimental consequences and discussion of each choice, each group or the class as a whole decides on the action to be taken by Governor Jones. Again, the "best" reasons for this action should be identified.

CHANGING ACTIVITIES

Describe how the listed activities will change if climate in your area changes.

	Hotter & Wetter	Hotter & Drier
School Class activities Sports — outdoor indoor Field trips Attendance at after school activities		
Home Family activities Activities with friends T.V. viewing Time spent indoors Chores - indoors Chores - outdoors		
Food Mealtimes Cost of food Types of food eaten		
Recreation & Entertainment Vacations Weekends Entertainment		
Clothing Types of clothes Costs		
Travel Local Long Distance		

AN EVALUATION OF POSSIBLE EFFECTS

THE SOIL AND WATER IN PARKLANDS BECOME MORE ACID

Immediate Consequences	Harm	Future Consequences	Harm
1.		1.	
2.		2.	
3.		3.	
4.		4.	
5.		5.	
6.		6.	

THE GLASS COMPANIES CLOSE DOWN, AND POWER PLANTS BURN LOW SULFUR & COAL

Immediate Consequences	Harm	Future Consequences	Harm
1.		1.	
2.		2.	
3.		3.	
4.		4.	
5.		5.	
6.		6.	

ACTIVITY 6: UNINTENTIONAL LAND CHANGES

PART A — The Expanding Desert — Introductory Readings

- **Reading 11:** "The Deserts are Coming"
- **Reading 12:** "Sahelian Drought: The Desert Advances"

Rainfall and temperature are major determinants of land characteristics however, humans' activities on the land also contribute, to a large degree, to changes in soil and atmospheric conditions. These readings describe desertification, a growing problem in many areas of the world. With increasing population and shrinking availability of agricultural lands, the effects of deteriorating croplands will present critical problems in the future, if not already so, in many areas of the world.

Student Activity: Dilemma Discussion

- DILEMMA 5: "Too Many Animals"

Garret Hardin's scenario "Tragedy of the Commons" is replayed here in the conflict between the need for food and over grazing sensitive, semi-arid pastures. It raises the age-old, persistent question, "How does one prioritize present needs against future needs?"

- DILEMMA 6: "A New Theory"

Planning and decision making depend to a large extent on scientific research and data. In the area of climate forecasts and the global environment much uncertainty exists. While decisions are continually being made based on limited information and untested theories, it is important that we understand the limits of what we "do" and "do not" know. The issues of this dilemma raise the question of scientific responsibility and public access to information. Ancillary to this issue is the suggestion that our industrial activities produce side effects which have far-reaching, drastic impacts on more sensitive ecological systems.

Use the basic procedure for conducting dilemma discussions as outlined in this guide.

PART B — Creating New Dangers on Land — Introductory Readings

- **Reading 13:** "Natural Disasters: The Human Hand"
- **Reading 14:** "Earthquake Hazards in the Mountains"

These two readings point out people's unwitting role in contributing to the severity of natural catastrophes. Earthquakes may seem to be less common occurrences but their effects are, without question, among the most destructive. More familiar to us living in the U.S. are flash floods and hurricanes. Thus the analogy can be made by considering the wisdom of our building on and paving over flood plains or living in hurricane prone areas.

As an extension activity following the dilemma discussion, have students research recent news articles about floods in nearby areas. This will demonstrate that what we do in a more highly technological society is not unlike that of people with more limited resources and opportunities.

Student Activity: Dilemma Discussion

- DILEMMA 7: "Courting Disaster"

This dilemma focuses on the issue of private and governmental responsibility in protecting against the loss of life and property. What is the proper role of government in protecting the welfare of its people? Should the freedom of choice be restricted?

Use the basic procedure for conducting dilemma discussions as outlined in this Teacher's Guide.

ACTIVITY 7: DIRECTIONS FOR THE FUTURE

In this culminating activity students will write a short essay that should incorporate some of the ideas and concerns brought out in this module. The essay should be written from the perspective of a leader of a society in the future who issues directives or a code of behavior for members of that society. This code should focus on the ways that people can live in greater harmony with their environment to insure its continued quality for present and future generations.

The questions in the student's manual may serve to assist them in developing their ideas. Students may find it more useful to focus on a single topic (e.g., agricultural, energy consumption, industrial activity, residential developments, etc.) and pursue that topic in greater depth and detail.

Have the students share their essays and discuss the goals and objectives they set out to achieve. They should comment on those goals which might be more easily achieved as well as those goals which might be more difficult to achieve.

SUGGESTED SCHEDULE OF ACTIVITIES*

Class Period	Activity
1	**Activity 1: Part A**
	— Reading 1
	— Individual group meetings.
	— Groups meet with one another.
2	**Activity 1: Part B**
	— Students prepare scientific explanation of rainfall.
3	**Activity 1: Part B**
	— Presentation to another group.
	— Discuss arguments/explanations presented.
	— Vote to accept or reject explanation.
4 (in class or homework assignment	**Activity 2: Part A**
	— Readings 2 and 3.
	— Discussion of readings.
	Part B
5	Case 1
	Case 2
6	Case 3
	Case 4
7	Case 5
	— Discussion of results and debriefing
	Activity 2: Part C
8	— Student groups write laws for State A.
9	— Complete set of laws in class discussion.
	Activity 3: Part A
10	— Readings 4 and 5
11	— Discussion: Dilemma 1
	Activity 3: Part B
12	— Readings 6 and 7
13	— Discussion: Dilemma 2
	Activity 3: Part C
14	— Group meetings
15	— Class Presentations
	Activity 4:
16	— Activity examples and discussions
17	**Activity 5: Part A**
	— Reading 8.
	— Discussion: Dilemma 3
18	**Activity 5: Part B**
	— Individual analysis. Student Handout 1.
	— Group discussions
19	— Group presentation.
	Activity 5: Part C
20	— Readings 9 and 10
21	— Discussion: Dilemma 4. Student Handout 2.
	Activity 6:
22	— Readings 11 and 12.
23	— Discussion: Dilemma 5.
24	— Discussion: Dilemma 6.
25	— Readings 13 and 14.
	— Discussion: Dilemma 7.
26	**Activity 7**
	— Students write "New Directives"

*The number of class periods devoted to this module can be reduced by assigning the readings for homework.

War Between The States

by Barry Mitzman

In the Pacific Northwest you can tell when summer is near — the rain gets warmer. People in the Northwest don't tan in the summertime. They rust.

Rain jokes. They have long been popular in the Pacific Northwest, emblazoned on T-shirts and posters and cocktail napkins, celebrating the region's almost constant but usually gentle wetness. Most folks here claim to like this rain, and during last year's relative drought, they complained. They say you can recognize a true Northwesterner by the moss growing on the north side of his or her nose.

But Northwesterners now are locked in serious battle — over the rain. Stored behind huge federally built dams on the Columbia and other rivers, rain and melted snow turn turbines producing 80 percent of the Northwest's electricity. That hydropower is cheap and clean, and was, until recently, abundant. But demand has grown, and the rivers were tamed long ago. There is not enough hydropower to go around. Northwest utilities, industries, and state and local governments are engaged in a literal power struggle over who will get it — and who will pay for constructing expensive new coal and nuclear power plants.

"The Northwest is poised for a regional civil war — an interstate battle over the allocation of low-cost federal power," Washington's flamboyant Gov. Dixy Lee Ray told a Congressional subcommittee last December. She exaggerated. No battlements have gone up along either side of the Columbia River dividing Oregon and Washington. But strange things are happening. To wit:

- The state of Oregon enacted legislation last summer that could put its investor-owned electrical utilities out of business, replacing them with a state-run power authority.
- Northwest aluminum manufacturers, who produce nearly one-third of all U.S. aluminum, are threatening to desert the region unless guaranteed huge amounts of cheap hydropower — power produced by the U.S. government at taxpayer's expense.
- The aluminum companies, along with the region's utilities, have had legislation introduced in Congress that would, among other things, eliminate the preference given to publicly owned utilities in the allocation of federal power — a move that could threaten the power supplies of public utilities in many parts of the country.

Behind these puzzling events lies a long and complex story. It involves the Bonneville Power Administration (BPA), the federal agency that sells and transmits hydropower from some 30 dams built in the Northwest by the Army Corps of Engineers and Bureau of Reclamation. BPA supplies utilities and electroprocess industries with half of all electricity used in the region. Bonneville's power marketing policies have long been controversial (EA, April 24, 1976), partly because BPA hydropower is so cheap. Northwest electric rates are, on average, half those in the rest of the country. Northwesterners also use about twice as much electricity per capita as consumers elsewhere. All-electric homes abound, and, as testimony to the low cost of hydropower, most are poorly insulated.

The region uses lots of electricity in part because of its electroprocess industries, primarily aluminum smelting. In the 1940s and 50s, when BPA power supplies far exceeded regional demand, the agency attracted industry with offerings of cheap hydropower and long-term contracts. Ten aluminum plants were built in the Northwest, plants that each year produce 1.6 million tons of aluminum and purchase BPA hydropower at about one-third of a cent per kilowatt-hour. Elsewhere they would pay three to five times as much. They consume awesome amounts of power: one-third of BPA hydropower, one-quarter of all power in the region. A new smelter planned for eastern Oregon would alone consume as much electricity as the 95,000 residents of Eugene, Oregon's second largest city.

BPA's founding legislation permits it to sell power directly to industry only after all residential and farm demand has been met. The Bonneville Project Act requires the agency in allocating power to give first preference to publicly owned utilities, then to investor-owned utilities.

By the early 1970s Bonneville could not continue to supply all three classes of customers. Available hydropower could not meet rising demand. But the aluminum plants could not be cut off, because in the mid-1960s BPA had signed new 20-year power contracts with them.

So instead BPA refused to renew shorter-term contracts with investor-owned utilities. Since 1973, BPA has supplied the region's eight private utilities with almost no power. They have had to scrounge for other

Reprinted by permission from *Environmental Action*, May 6, 1978 © 1979 ENVIRONMENTAL ACTION, 1346 Connecticut Ave., NW, Washington, D.C.

sources, and have made massive investments in new nuclear and coal power plants. As a result, electric rates of private utilities have skyrocketed. The region's 100 public utilities, continuing to receive BPA power, have had only modest rate increases.

Most Washington cities and counties long ago set up their own public electrical utilities, which today serve two-thirds of the state's residents. In Oregon and Idaho, however, 80 percent of consumers are served by private power companies. That means most BPA power now is going to Washington consumers, while their neighbors are hard hit by private utility rate hikes. Thus are planted the seeds of interstate enmity.

In Portland, customers of investor-owned Portland General Electric Company pay about $27 for each 1000 kilowatt-hours of electricity. Just across the Columbia River, in Vancouver, Wash., residents pay the local public utility about $10 for the same amount of power. Last year the city of Portland tried to obtain BPA power for its residents by setting up a municipal utility. Bonneville rejected the city's request, saying all power was already commited. Portland then filed suit in federal court, charging BPA with violating the Bonneville Project Act by denying power to utilities while selling it to industry. The suit has not yet come to trial.

A larger and perhaps more serious claim on BPA power has been made by Oregon's rather colorless but hard-working governor, Bob Straub. Last year Straub pushed through the state legislature a bill establishing the Oregon Domestic and Rural Power Authority (DRPA), the nation's only state-run electric company. DRPA is set to begin operations in 1979. It is empowered to acquire electricity for distribution to Oregon homes and farms over transmission lines to be leased from local utilities.

DRPA's importance is that a state-wide public utility would qualify as a BPA preference customer, where Oregon's private utilities do not. Though Benneville is saying now that no power is available to new customers, Straub is looking to 1981, when the aluminum companies' BPA power contracts begin to expire. Then, under present law, Bonneville would be required to redistribute that industrial power to meet the needs of public utilities. Straub wants Oregon to be first in line.

"We will be able to lower rates because we can buy less costly power," Straub has said. "And since the state would neither make a profit nor add substantial new expenses to the rate-payers' burden, this plan will reduce the price Oregon consumers pay for electricity."

Straub estimates DRPA could lower Oregon electric bills by $40 million annually. But Oregon's private utilities regard DRPA as a thinly disguised attempt to "nationalize" their business. And Washington's public utilities regard DRPA as a threat — a competitor for BPA's limited hydropower. It was DRPA that inspired Gov. Ray to declare regional civil war.

"One possible line of defense in response to the threats from across the river is to enact a domestic and rural power authority of our own, and we will if we must," Ray said. Idaho Gov. John Evans has said that his state — like Oregon, cut off from most BPA power — might also be forced to form its own state public utility.

The governors' disquiet is matched by that of the aluminum companies, for BPA has notified them that their present power contracts will not be renewed. The industry will be forced to seek power from new thermal power plants planned by private utilities. But these plants face long regulatory delays, and the plants' output will be at least 10 times more expensive than BPA hydropower. Aluminum executives claim that the costs of purchasing new thermal power might price Northwest aluminum out of world markets and force the industry to leave this region, taking with it some 12,000 jobs.

"Without some assured energy supply, our industry would have to relocate," says James Van Jr., Northwest manager of Alcoa. (Ironically, aluminum is much in demand now because of the energy crisis: automakers are using more aluminum in cars to reduce their weight and thus improve gas mileage.)

To protect their interests, public and private utilities and the aluminum industry have formed the Pacific Northwest Utilities Conference Committee. PNUCC met regularly during most of last year, in secret. The cabal came up with a piece of legislation — the Pacific Northwest Electric Power Supply and Conservation Act — and had it introduced in Congress by Sen. Henry Jackson and Rep. Lloyd Meeds, Washington Democrats.

The PNUCC bill would insure that all three groups — industry and utilities, public and private — receive some cheap BPA power and share in the costs of building new thermal power plants. The bill would make BPA a regional power broker for both federal hydropower and utility-owned thermal power. Bonneville would purchase the output of all existing and planned thermal plants in the region, would pool this more expensive power with federal hydropower, and would sell both to utilities and industry at an "averaged" price.

The aluminum companies would give up their present contractual rights to BPA hydropower, but would receive mixed hydro and thermal power for at least 35 years. Power costs would rise, but not as much as with thermal power alone. Industry would still be paying "a shade below" the average price of power in other regions, according to Robert Ferrie, president of Intalco Aluminum Company.

That sounds innocuous. It's not.

Private utilities would gain most from the PNUCC bill. They would have immediate access to some cheap BPA hydropower. They would receive protection from public take-over tries by the likes of Oregon's DRPA, because only present BPA customers would be allowed in on the hydro-sharing agreement. And Bonneville would guarantee to purchase the output of private utilities' planned nuclear plants, no matter how expensive that power turns out to be. BPA's guarantee would make it easier and cheaper for private utilities to obtain financing for construction. In effect, BPA would subsidize private nuclear power, buying it from the utilities at one price and then selling it back to them, pooled with hydropower, at a lower price.

And that's not all. The PNUCC bill would have public utilities give up their right to all available hydropower. They would receive only about enough hydropower to

meet their projected needs in 1983. To meet growth in demand for power beyond that, they would be forced, like aluminum companies and private utilities, to buy mixed hydro and thermal power. That would more than double most public utilities' rates.

Some public utilities have supported the PNUCC bill as a way of defeating DRPA and speeding power plant construction. But when a House water and power subcommittee held regional hearings on the bill last December, the PNUCC coalition crumbled a bit. The Snohomish County Public Utility District (PUD), one of Washington's largest, came out in opposition to the bill.

"I cannot tell my customers that they should pay more for their power so that a private utility elsewhere can pay less," said William Hulbert, Snohomish PUD chairman. Hulbert argued that BPA should reserve the benefits of federal power for the people, "and not the stockholders of private companies."

Others attacked the bill too. Though it would reduce private utility rates somewhat, thus benefiting most Oregon consumers, Gov. Straub estimated that the bill would leave private utility rates 70 percent higher than public rates. He demanded a gap of no more than 30 percent and threatened to use DRPA to get it.

Environmental groups lined up in opposition, some arguing that federal backing for private nuclear power plants would encourage massive overbuilding.

"It opens the floodgates to accelerated growth, and provides federal subsidies to carry out the process," said Mark Ingram, director of the Idaho Conservation League.

Echoing that view was Rep. James Weaver (D-Ore.), a member of the water and power subcommittee, PNUCC, he said, "would pick the pockets of ratepayers by building expensive new thermal plants whether we need them or not."

Weaver's has been a lonely voice advocating a largely overlooked solution to Northwest energy problems: conservation. Private utilities may not need those new nuclear plants, he says. Indeed, the utilities are delaying plant construction because regional power demand is growing more slowly than expected — last year, by just 1 percent. A recent study by the Natural Resources Defense Council found that an intensive conservation program, including full insulation of homes and penalty pricing for excessive power users, could delay need for new Northwest power plants for 15 years. A study by the Pacific Northwest Regional Commission suggests that "politically acceptable" conservation measures could cut present consumption by 11 percent.

One perhaps brutal way to conserve hydropower would be to deny it to the aluminum industry, which consumes one-third of all BPA power but provides less than 3 percent of Northwest jobs, according to a recent study by the Washington state Commerce Department. If BPA industrial power were redistributed, according to Terry Lash of the Natural Resources Defense Council, "the Northwest would get a lot more employment than it does from aluminum."

Weaver has introduced his own regional power legislation, which would allocate an equal share of federal hydropower to all domestic and rural consumers throughout the region, whether served by a public or private utility. Industry would pay the higher costs of private hydro and thermal power, as would households using more than their share of federal hydropower.

Weaver's bill would mean much higher energy costs for the aluminum companies, should they choose to stay in the Northwest. The bill would channel federal hydropower to private utilities, thus equalizing rates in Oregon and Washington and persumably satisfying Straub. But since Weaver's bill is anathema to Washington public utilities, and since Henry Jackson chairs the Senate Energy and Natural Resources Committee, the bill appears doomed.

Yet the PNUCC bill's future is not bright either. The hearings brought out strong and widespread opposition, even within PNUCC itself. Among Northwest governors, only Ray favored the plan. Public power interests in other parts of the country are beginning to take a hard look at it and are loathe to see any public utility forfeit preferential rights to federal power.

"We're concerned that a precedent will be established that could affect public power in other areas." said Jeffrey Nelson of the Midwest Electric Consumers Association. Last year the American Public Power Association, representing 1400 public utilities throughout the United States, rejected a resolution endorsing the PNUCC bill and set up a 40-member task force to investigate it.

That kind of national attention has all Northwest interests a little worried. People in California and the Southwest might begin wondering why the Northwest receives a disproportionate share of cheap hydropower from federal dams. Other regions might themselves make a bid for BPA power.

"Our inequities look pretty attractive to folks in other parts of the country who pay five times as much as we do," said Sterling Munro, newly appointed BPA head. "We can't afford to get into a situation where other parts of the country believe that we're in a cat-and-dog fight in our own region."

It remains to be see whether the Northwest can come up with a solution agreeable to all competing interests. The spotlight now shifts to Henry Jackson, who from his powerful committee chairmanship can push through just about any regional energy legislation he wants. Jackson has stayed out of the debate thus far. He introduced the PNUCC bill, but carefully refrained from endorsing it. He is known to be sympathetic to the aluminum manufacturers, and he must safegard the interests of his state's public utilities. But to do that he must find some way to avoid the radical change that Oregon's DRPA could cause.

One thing is certain. About this time of year, the rain gets warmer.

Power to the people

For citizen activists, the Northwest power debate can be depressing. Oregon is pitted against Washington in a battle over hydro-electricity, power that is, after all, owned by all Americans. Some public power utilities, owned and supposedly controlled by the people they serve, have entered into an unholy alliance with private utilities and industry to spread the hydropower around and hurry the dawning of a nuclear age. The cause of conservation seems to lack any institutional advocate, save Rep. James Weaver (D-Or.), who is mostly ignored. The Ecotopian dream appears tattered indeed. Who represents the public interest?

In just the past month an eminently reasonable voice has been raised, that of Seattle's new mayor, Charles Royer. Seattle's half-million residents are supplied power by Seattle City Light, the largest and one of the oldest public utilities in the Northwest. It is an unusually well-managed outfit, with the lowest rates to be found in any major United States city — thanks not only to federal hydropower, but also to City Light's aggressive development of its own hydropower dams in the North Cascade mountains.

While private power companies are accountable only to investors (who care about their dividends and little else), municipal utilities like Seattle City Light are controlled by elected city officials who must answer to a mayor and city council, and therefore tend to be more reponsive to the public will. Even public utility districts (PUD's), public agencies serving several local government jurisdictions, are not so closely tied to a local constituency as municipal power companies. Significantly, some PUD's have been among the strongest supporters of the PNUCC bill (see other story), though other PUD's are opposed.

Pressed for power two years ago, Seattle City Light proposed to join a utility consortium building a nuclear plant near Richland, Wash. City Light administrators campaigned hard for the proposal, but the city council came up with a different plan, energy conservation. The result: utilities in the consortium, burdened by huge construction costs, have had to jump their rates repeatedly, while City Light has not had a rate increase since April of last year, and won't have one for the rest of this year because conservation efforts are working.

Seattle opposes the PNUCC bill, rejecting any change in the public preference clause of the Bonneville Project Act. While the PNUCC bill would let utility representatives set regional energy policy, Seattle has called for a policy commission made up of public representatives, with utilities only advising.

Seattle says future power needs should be met by the most cost-effective means possible, which means conservation — estimated to cost about one-sixth as much as nuclear power. The city urges adoption of energy-efficiency standards for new buildings and appliances, plus a requirement that insulation be improved in existing structures when sold. Conservation should be encouraged with a $500 million fund for insulation loans and grants to be administered by the Bonneville Power Administration, which also should impose rate penalties against utilities and industrial customers that do not take steps to conserve energy.

Seattle's position does not answer all the issues in the Northwest power debate. There is no provision for a fairer distribution of federal power to Oregon consumers. But Oregonians arguably have taken care of that themselves, by moving to establish a public power utility, joining Seattle and most of the rest of Washington. In setting forth Seattle's position. Mayor Royer spoke strongly for the special responsibilities of public utilities.

"Public power was established and exists today solely for the benefit of its customers," he said. "Private power, no matter how enlightened, exists primarily to benefit its stockholders. The people do not elect public power. That mandate to us means we must provide the yardstick in public power for measuring how the public interest is served."

— B.M.

AN ACT

To authorize and direct the Secretary of Commerce to develop a national policy on weather modification, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled. That this Act may be cited as the "National Weather Modification Policy Act of 1976".

SEC. 2. DECLARATION OF POLICY.

(a) FINDINGS — The Congress finds and declares the following:

- Weather-related disasters and hazards, including drought, hurricanes, tornadoes, hail, lightning, fog, floods, and frost, result in substantial human suffering and loss of life, billions of dollars of annual economic losses to owners of crops and other property, and substantial financial loss to the United States Treasury;
- Weather modification technology has significant potential for preventing, diverting, moderating, or ameliorating the adverse effects of such disasters and hazards and enhancing crop production and the availability of water;
- The interstate nature of climatic and related phenomena, the severe economic hardships experienced as the result of occasional drought and other adverse meteorological conditions, and the existing role and responsibilities of the Federal Government with respect to disaster relief, require appropriate Federal action to prevent or alleviate such disasters and hazards; and
- Weather modification programs may have long-range and unexpected effects on existing climatic patterns which are not confined by national boundaries.

(b) PURPOSE — It is therefore declared to be the purpose of the Congress in this Act to develop a comprehensive and coordinated national weather modification policy and a national program of weather modification research and development —

- to determine the means by which deliberate weather modification can be used at the present time to decrease the adverse impact of weather on agriculture, economic growth, and the general public welfare, and to determine the potential for weather modification;
- to conduct research into those scientific areas considered most likely to lead to practical techniques for drought prevention or alleviation and other forms of deliberate weather modification;
- to develop practical methods and devices for weather modification;
- to make weather modification research findings available to interested parties;
- to assess the economic, social, environmental, and legal impact of an operational weather modification program;
- to develop both national and international mechanisms designed to minimize conflicts which may arise with respect to the peaceful uses of weather modification; and
- to integrate the results of existing experience and studies in weather modification activities into model codes and agreements for regulation of domestic and international weather modification activities.

SEC. 3. DEFINITIONS.

As used in this Act:

- The term "Secretary" means the Secretary of Commerce.
- The term "State" means any State of the United States, the District of Columbia, or any Commonwealth, territory, or possession of the United States.
- The term "weather modification" means any activity performed with the intention and expectation of producing changes in precipitation, wind, fog, lightning, and other atmospheric phenomena.

SEC. 4. STUDY.

The Secretary shall conduct a comprehensive investigation and study of the state of scientific knowledge concerning weather modification, the present state of development of weather modification technology, the problems impeding effective implementation of weather modification technology, and other related matters. Such study shall include —

- a review and analysis of the present and past research efforts to establish practical weather modification technology, particularly as it relates to reducing loss of life and crop and property destruction;
- a review and analysis of research needs in weather modification to establish areas in which more research could be expected to yield the greatest return in terms of practical weather modification technology:
- a review and analysis of existing studies to establish the probable economic importance to the United States in terms of agricultural production, energy, and related economic factors if the present weather modification technology were to be effectively implemented;
- an assessment of the legal, social, and ecological implications of expanded and effective research and operational weather modification projects;
- formation of one or more options for a model regulatory code for domestic weather modification activities, such code to be based on a review and analysis of experience and studies in this area, and to be adaptable to State and national needs;
- recommendations concerning legislation desirable at all levels of government to implement a national weather modification policy and program;
- a review of the international importance and implications of weather modification activities by the United States;
- a review and analysis of present and past funding for weather modification from all sources to determine the sources and adequacy of funding in the light of the needs of the Nation;
- a review and analysis of the purpose, policy, methods, and funding of the Federal departments and agencies involved in weather modification and of the existing interagency coordination of weather modification research efforts;
- a review and analysis of the necessity and feasibility of negotiating an international agreement concerning the peaceful uses of weather modification; and
- formulation of one or more options for a model international agreement concerning the peaceful uses of weather modification and the regulation of national weather modification activities; and a review and analysis of the neccessity and feasibility of negotiating such an agreement..

SEC. 5. REPORT.

(a) IN GENERAL — The Secretary shall prepare and submit to the President and the Congress, within 1 year after the date of enactment of this Act, a final report on the findings, conclusions, and recommendations of the study conducted pursuant to section 4. Such report shall include:

- a summary of the findings made with respect to each of the areas of investigation specified in section 4;
- other findings which are pertinent to the determination and implementation of a national policy on weather modifications;
- a recommended national policy on weather modification and a recommended national weather modification research and development program which is consistent with, and likely to contribute to, achieving the objectives of such policy;
- recommendations for levels of Federal funding sufficient to support adequately a national weather modification research and development program;
- recommendations for any changes in the organization and involvement of Federal departments and agencies in weather modification which may be needed to implement effectively the recommended national policy on weather modification and the recommended research and development program; and
- recommendations for any regulatory and other legislation which may be required to implement such policy and program or for any international agreement which may be appropriate concerning the peaceful uses of weather modification, including recommendations concerning the dissemination, refinement, and possible implementation of the model domestic code and international agreement developed under the specifications of section 4.

Each department, agency, and other instrumentality of the Federal Government is authorized and directed to furnish the Secretary any information which the Secretary deems necessary to carry out his functions under this Act.

- Operation and Consultation. — The Secretary shall solicit and consider the views of State agencies, private firms, institutions of higher learning, and other interested persons and governmental entities in the conduct of the study required by section 4, and in the preparation of the report required by subsection (a).

SEC. 6. AUTHORIZATION FOR APPROPRIATIONS.

- There is authorized to be appropriated to the Secretary for the purposes of carrying out the provisions of this Act not to exceed $1,000,000.
- Section 6 of the Act entitled "An Act to provide for the reporting of weather modification activities to the Federal Government", approved December 18, 1971 (85 Stat. 736; 88 Stat. 1212: 15 U.S.C. 330e), is further amended by striking out "1973, 1974, 1975, 1976, and 1977," and inserting in lieu thereof "1973 through 1980."

Approved October 13, 1976.

Environmental Modification

I. General Environmental Readings (sourcebooks, collected essays, etc.)

Barnett, John (ed.) *Our mistreated world*, Princeton, N.J.: Dow Jones Books, 1970.

Burton, Ian, Robert Kater and Gilbert White. *The environment as hazard*, New York: Oxford University Press, 1978.

Caldwell, Lynton, Hayes, Lynton, and Isabel MacWhirter. *Citizens and the environment: case studies in popular action*. Bloomington: Indiana Univ., 1976.

Ehrlich, Paul R., and Anne H. Ehrlich. *Ecoscience*, San Francisco: W.H. Freeman, 1977.

Hinrichs, Noel. *Population, environment and people*. New York: McGraw-Hill, 1971.

Holdren, John P. and Paul Ehrlich. *Global ecology: readings toward a rational strategy for man*. New York: Harcourt Brace Jovanovich, Inc. 1971.

Johnson, Cecil. *The natural world: chaos and conservation*. New York: McGraw Hill, 1972.

Revelle, Roger and Hans H. Landsberg (Eds.) *America's changing environment*. Boston: Beacon Press, 1970.

Revelle, Roger, A. Khosla and M. Vinovskis. *The survival equation: man, resources and his environment*, Boston: Houghton Mifflin, 1971.

Rose, J. (ed.) *Technological inquiry: the effect of technological advances on environment, life and society*. London: Gordon and Breach Science Publishers, 1969.

Smith, Robert Leo. *The ecology of man: an ecosystem approach*. New York: Harper and Row, 1972.

Strong, Maurice F. (ed.) *Who speaks for earth?* New York: W.W. Norton and Co., 1973.

Thomas, William L. *Man's role in changing the face of the earth*. Chicago: Univ. of Chicago Press, 1956

Winn, Ira J. *Basic issues in environment*, Columbus, Ohio: Charles E. Merrill Pub. Co., 1972.

II. Land Modifications

Balt, Bruce. *Earthquakes, a primer*. San Francisco: W.H. Freeman, 1978.

Brooks, Robert R. "People vs. food," *Saturday Review*, September 5, 1970.

Brown, Lester, and E. Eckholm. *By bread alone*, New York: Praeger, 1974.

Brown, Lester. *The twenty-ninth day: accommodating human needs and numbers t. the earth's resources*, New York: Norton, 1978.

Bryson, Reid. Drought in Sahelia: who or what is to blame. *The Ecologist*, 3, 1973, 366-371.

Eckholm, Erik. *Losing ground*, W.W. Norton, Inc., New York: N.Y., 176.

Eckholm, Erik and Lester Brown. *Spreading deserts - the hand of man*. World Watch Paper #13, August 1977.

Glantz, N. The Sahelian drought. *Africa Today*, 22(2), 1975, 57-61.

Hewitt, Kenneth. "Earthquake hazards in the mountains," *Natural History*, May 1976.

Kates, Robert et al. Human impact of the Managua earthquake. *Science*, 182, 1973, 981-990.

Loraine, John A. *The death of tomorrow*, Philadelphia, Pa.: J.B. Lippincott Co., 1972.

Lord, Russell. *The care of the earth: a story of husbandry*, New York: The New American Library, 1962.

Waterbury, John. "Egypt's Staff of Life," *Common Ground*, July, 1975.

III. Modification of Plant and Animal Life

Curry-Lindall, Kai. *Let them live: a world-wide survey of animals threatened with extinction*, New York: William Morrow & Co., 1972.

Dubos, Rene. *A God within*. New York: Charles Scribner Sons, 1972.

Huebner, Albert. Forests: the lungs of the world. *The Humanist*, Jan/Feb. 1980, 34-56.

Lovejoy, Thomas. "We must decide which species will go forever," *The Smithsonian*, July, 1976.

Meyers, Norman. "An expanded approach to the problem of disappearing species," *Science*, 1/16/76.

Milne, Lorus and Margery Milne. *The cougar doesn't live here anymore*. Englewood Cliffs, N.J.: Prentice Hall, Inc., 1971.

Storr, Antony. "Man's relationships with the natural world," *The North American Review*, Winter, 1974.

IV. Weather and Climate Modifications

Bach, Wilfrid. *Atmospheric pollution*, New York: McGraw-Hill, 1972.

Calder, Nigel. *The weather machine, how our weather works and why it is changing*. Viking Books, 1974.

Ferrar, Terry. *The urban costs of climate modification*, New York: John Wiley & Sons, 1976.

Hemel, Eric and Clifford Holderness. *An environmentalist's primer and weather modification*. Stanford, Ca.: Stanford Environmental Law Society, 1978.

Kellogg, William and S.H. Schneider. Climate stabilization for better or worse? *Science*, 186, 1974, 1163-1172.

Matthews, William H., William W. Kellogg and G.D. Robinson (eds.) *Man's impact on climate*, Cambridge, Mass., MIT Press, 1971.

Schneider, Stephan, Mesirow, Lynne E. *The genesis strategy: climate and global survival*, New York: Dell Publishing Co., 1976.

Thomas, William (ed.) *Legal and scientific uncertainties of weather modification*, Durham, N.C., Duke University press, 1977.

Weather Modification Advisory Board. *The management of weather resources, Vol. 1, Proposals for a National Policy and Program*. Washington, D.C.: U.S. Gov't. Printing Office, 1978.

Young, Louise. *Earth's aura*, New York: Alfred A. Knopf, 1977.

V. Selected Student Readings

Moore, Ruth, *Man in the environment*, New York: Alfred A. Knopf, 1975.

Roberts, Walter A. We're doing something about the weather. *National Geographic*, 141(4), April, 1972, 518-555.

Roth, Charles E. *The most dangerous animal in the world*, Reading, Mass.: Addison-Wesley, 1971.